ZEUS-DO: A Design Oriented CFD-Based Unsteady Aerodynamic Capability for Flight Vehicle Multidisciplinary Configuration Shape Optimization, Phase I

Completed Technology Project (2009 - 2009)

Project Introduction

In practically all air-vehicle MDO studies to date involving configuration shape optimization, dynamic Aeroservoelastic constraints had to be left out. Flutter, gust stresses, vibration, and ride comfort cannot still be accounted for in MDO involving configuration shape variations. Development of the missing MDO building block is proposed here: A design-oriented ZEUS-DO CFD-based unsteady aerodynamic capability with 3D configuration shape sensitivities, integration with commercial structural finite element codes and with aeroelastic / aeroservoelastic stability / response behavior analysis and sensitivity analysis in the time and frequency domains for non-linear and linearized flows. Phase I will focus on shape parametrization and mesh, pressure, and generalized force sensitivities with respect to shape design variables of multi-lifting-surface configurations. Accuracy and numerical efficiency of the new capability will be demonstrated. In Phase II the ZEUS-DO development effort will proceed to complex 3D configurations including fuselages, nacelles, and external stores. Integration with structural Finite Element design-oriented codes and aeroelastic stability / response solvers, together with validation, assessment of numerical efficiency, and commercialization will be pursued. The new ZEUS-DO capability will provide rapid CFD-based unsteady aerodynamic modeling, analysis, sensitivity analysis, and approximation for re-analysis and for optimization with industry standard accuracy and complexity of configurations modeled.

Anticipated Benefits

Potential NASA Commercial Applications: Because of its generality and its ZAERO-based geometry parametrization, which is already compatible with industry standard CAD and Finite Elements aeroelastic codes such as NASTRAN and ASTROS, it is expected that companies and agencies outside of NASA will be able to quickly integrate the new ZEUS-DO into their own MDO systems. Applications of ZEUS-DO to the configuration shape optimization of flight vehicle will include all types of fixed wing vehicles, conventional and revolutionary.

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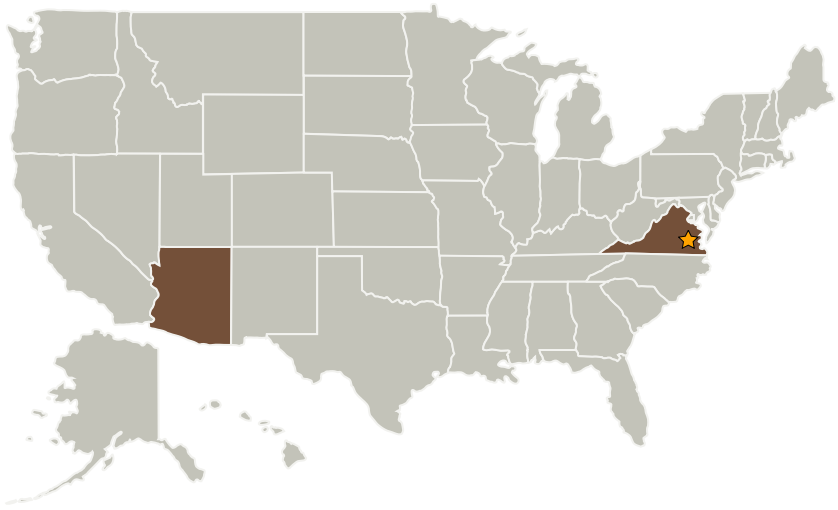
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
ZONA Technology, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Scottsdale, Arizona

Primary U.S. Work Locations	
Arizona	Virginia

Project Transitions

January 2009: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

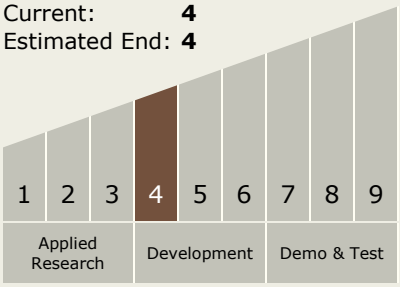
Carlos Torrez

Principal Investigator:

Ping-chih Chen

Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **4**



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July 2009: Closed out

Closeout Summary: ZEUS-DO: A Design Oriented CFD-Based Unsteady Aerody namic Capability for Flight Vehicle Multidisciplinary Configuration Shape Optimiz ation, Phase I Project Image

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity